

A Philosophical Inquiry into the Character of Material Artifacts

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Résumé : Ce texte vise à montrer les ressources variées de la thèse des trois mondes de Karl Popper dans l'analyse des questions liées au statut ontologique des artefacts matériels. Bien qu'elle ait été discutée depuis des années, et qu'elle ait fait l'objet de nombreuses critiques, on n'a presque pas remarqué que la thèse de Popper fournit d'excellentes idées pour la description philosophique des artefacts. Ce texte comprend deux sections. Dans la première, on donne un exposé critique des thèses de Popper quant à la réalité et à l'autonomie (partielle) des artefacts. La seconde section présente deux arguments. Le premier se concentre sur la composition et les caractéristiques des artefacts matériels, et le second souligne leurs aspects créatifs et épistémiques.

Abstract: This paper aims to display the versatility of Karl Popper's thesis of three worlds in the analysis of issues related to the ontological status and character of material artifacts. Despite being discussed over years and hit with numerous criticisms it was hardly ever noticed that Popper's thesis provides excellent insights into the philosophical account of artifacts. There are two sections in this paper. The first section presents a critical exposition of Popper's account of reality and (partial) autonomy of artifacts. The second section consists of two arguments. The first argument focuses on the composition and characteristics of material artifacts and the second one emphasizes their creative and epistemic aspects.

1 Introduction

This paper aims to display the versatility of Popper's thesis of three worlds in the analysis of issues related to the ontological status and character of mate-

rial artifacts [Popper 1972, 1979, 1982], [Popper & Eccles 1977].¹ Strange to say, despite being discussed over years and hit with numerous criticisms [Carr 1977], [Currie 1978], [Cohen 1980], it was hardly ever noticed that Popper's thesis provides excellent insights into the philosophical account of artifacts.² His key perspectives on the reality, (partial) autonomy, and ontological status of artifacts were not considered by contemporary scholars known to be engaged in the philosophical study of artifacts.³ The present paper addresses this oversight.

There are two sections in this paper. The first section presents a critical exposition of Popper's account of reality and (partial) autonomy of artifacts. Recent discussions about the longstanding distinction between natural objects⁴ and artifacts are brought up and the relevance of Popper's pluralistic thesis to this debate is pointed out. In addition, attention is drawn towards how to read his notion of the (partial) autonomy of artifacts. The second section examines the ontological status of artifacts. Two arguments are posed to challenge the dual ontological status of what Popper called "embodied" World 3 objects [Popper & Eccles 1977]. The first argument focuses on the composition and distinctive features of material artifacts and the second one emphasizes their creative and epistemic aspects.

2 Popper on the reality and (partial) autonomy of artifacts

The age-old distinction between artifacts and natural objects, the origin of which can be traced back to Aristotle, is often taken as a starting point in the philosophical discussions of artifacts. On the face of it, artifacts are distinguished from natural objects in that they are apparently mind-dependent, at least in the sense that they would not exist were it not for the (mental and physical) activities of human beings who make and use them. This apparent mind-dependence of artifacts raises distinctive metaphysical suspicions against them because an object is usually assumed to be a genuine part of our world if it possesses a nature which is entirely independent of human concepts,

1. The term "material artifact" refers to any tangible product of human intellectual and physical activities, consciously conceived, manufactured or modified in response to some need, want or desire to produce an intended result. Artifacts are not necessarily tangible in nature. For instance, software programs, designs or diagrams are also products of human labor intended to meet certain goals but are literally intangible. Dasgupta classifies such entities as "abstract artifacts" [Dasgupta 1996, 11].

2. In this study the terms "artifact" and "material artifact" are used interchangeably.

3. See, for instance, the works of [Baker 2004, 2008], [Thomasson 2003, 2009], [Kroes & Meijers 2006].

4. "Natural object" here means that which is produced or developed by natural processes without slightest human intervention.

language, practices, etc., and is open to discovery. Since artifacts seem to depend for their existence, nature and classification on human beliefs, intentions, representations, knowledge and practice, a large number of philosophers hold them ontologically in low regard, that is, do not consider them as genuine parts of the world. The apparent mind-dependence of artifacts continues to raise doubts about their *real* existence and the natural-artificial distinction is still a matter of intense dispute as can be witnessed in a series of recently published articles.

Baker [Baker 2008], for instance, examines the five possible ways shown by Wiggins [Wiggins 2001] of differentiating natural objects (or ontologically genuine substances) from artifacts and argues that the mind-dependency of artifacts does not entail any ontological deficiency in them. Moreover, the alleged difference between natural objects and artifacts, she says rather pointedly, is steadily shrinking anyway because modern technology is creating products like digital organisms or bacterial batteries that are difficult to classify unambiguously as artifacts or natural objects [Baker 2008, 2–5]. Preston, in contrast, argues that the natural-artificial divide began to fade long ago with the development of ancient methods of domestication and fermentation [Preston 2008, 26–28]. On ground of the absence of a sharp natural-artificial divide she challenges the perceived significance of the more general distinction between mind-dependent and mind-independent entities often used to support the orthodox view of artifacts being ontologically inferior to natural objects. Kroes & Vermaas agree with Preston that the natural-artificial distinction became blurred the moment human beings started using and modifying natural objects to meet their ends [Kroes & Vermaas 2008, 28–31]. However they focus on those cases where the difference between artifacts (say a Hubble telescope) and natural objects appears reasonably clear and argue, siding with Baker, that this difference does not necessarily involve any ontological deficiency in artifacts.

Regardless of their conflicting views on the sharpness of the natural-artificial divide these contemporary scholars applaud Baker for making the point that though artifacts depend on human minds or intentions in ways that natural objects do not, this mind-dependency does not necessarily imply that artifacts are not genuine parts of our world. The very idea that mind-dependence or intention-dependence⁵ does not entail any ontological deficiency in artifacts generates in turn the need to seek an image of reality that is broad enough to accommodate artifacts in metaphysical schemes.

A possible solution to this appeal to a more comprehensive picture of reality can be found in Popper's theory of three ontologically distinct worlds [Popper 1972, 1979, 1982] and [Popper & Eccles 1977], (namely, World 1, World 2, and World 3) acting upon and partially overlapping each other. This theory separates World 1 (the world of physical states, events, laws, animate and in-

5. Here I assume no difference between mind-dependence and intention-dependence.

imate objects) from World 3 (the world of human creations) on the one hand and emphasizes the reality, objectivity, and partial autonomy of these World 3 products on the other. True, material artifacts such as tools and machines do not hold center stage in Popper's exposition of the elements of World 3. Theories, propositions, the abstract yet objective contents of scientific, mathematical or poetic thoughts, problem-situations and critical arguments are held by him as the most fertile World 3 citizens. Nevertheless, this distinct world of human creation includes ethical values, social institutions, paintings, sculptures, and tools or what Popper calls, "feats of engineering" such as, machines, aircrafts, computers and scientific instruments [Popper 1979]. Drawing on the richness and diversity of the contents of World 3, it would not be too difficult to extract an account of material artifacts.

As already said, possessing discoverable mind-independent natures is usually held to be the central criterion for treating entities as real or genuine parts of our world. The implication is clear: artifacts generally viewed as not having mind-independent natures accessible to scientific examination, are not real. One can spot at least two different senses in which artifacts seem to be mind-dependent. The first sense of dependence is a simple causal matter where the intentional activities of humans are causally responsible for the production of artifacts. In the other and philosophically more interesting sense, artifacts are not just causally but *existentially* dependent on human intentions since it is metaphysically necessary for something to be an artifact (as opposed to, say, a stone) that there be human intentions to create that very kind of object. As Hilpinen notes, unlike garbage and pollution, artifacts proper must be not merely the products of human activities, but the *intended* products of intentional human activities [Hilpinen 1992, 60]. This very idea that artifacts are existentially mind-dependent makes many metaphysicians hesitant to acknowledge their existence as it tends to imply that human thought and intentions are sufficient to bring new entities into being, like a rabbit in a hat by a conjuring trick. Usually it is this kind of worry that leads some metaphysicians to believe that artifacts are not real parts of our world. But it is important not to confuse the claim that artifacts are existentially dependent on human intentionality with the rather crazy view that human intentions, practices, beliefs or desires *alone* are sufficient to bring artifacts into existence.

On the other hand the idea that mind-dependency entails ontological inferiority has been challenged from two different perspectives. Firstly, some contemporary metaphysicians insist on rejecting mind-independence as *the* criterion of real existence. For instance, Thomasson argues, the very thought that to be real artifacts must have mind-independently discoverable natures is based on "illegitimately generalizing from the case of scientific entities" [Thomasson 2008, 25]; hence this general, across-the board criterion of mind-independence as *the* criterion for the existence of "anything whatsoever" should be given up.

Secondly, the other relatively older point of view [Simon 1969], [Lososky 1990] upholds that artifacts, despite being human creations, may have intrinsic natures every bit as open to error or scientific discovery as the natures of chem-

ical or biological kinds are. The main proposal along these lines [Simon 1969, 6–9] is that the purposeful aspect of any artifact involves a relation among three terms, namely, the purpose or goal, the inner character of the artifact and the outer environment in which the artifact performs. To illustrate, a clock will serve its intended purpose only if its inner environment (say, the arrangement of gears, the application of the forces of springs or gravity operating on a weight or pendulum) is appropriate to the outer environment—the surroundings in which it is to be used. Evidently, natural science impinges on an artifact through two of these three terms of the relation that characterizes it: the inner structure of the artifact itself and the outer environment in which it will perform.

Lososky makes a similar point in emphasizing the inner structure of an artifact as one of the three important features of artifact's nature [Lososky 1990]. This inner structure contributes to an artifact's performance. In addition, two other features, the purposes for which it is used and how it is used for those purposes also belong to the nature of an artifact. Simply knowing how to use an artifact, say, a clock, argues Lososky, does not guarantee any familiarity with its intrinsic nature—the nature as constituted by these three features requires to be scientifically studied [Lososky 1990].

In the circumstances, a critical study of Popper's pluralistic theory seems necessary because of its novelty and historical priority. To explain, Popper's theory offers a fresh, new way of regarding artifacts as ontologically respectable aspects of reality without ignoring the fact of their mind-dependency and more interestingly, without involving the condition of having discoverable mind-independent natures. What is more, two crucial claims regarding the ontological status of artifacts can be found in Popper much before they have been put forward by present-day philosophers. The claims are: first, artifacts being products of human creation are ontologically different from but not necessarily ontologically inferior to natural (that is, World 1) objects; second, the *kickability* of artifacts, that is, the fact that they can be kicked and can, in principle kick back [Popper 1982, 116], is to be taken as evidence to substantiate their reality and (partial) autonomy. In what follows, these claims will be examined one by one.

Popper's argument for introducing an ontologically distinct World 3 rested primarily on the division he made between World 2 *thought processes* and World 3 *thought contents*. The objective thought contents of World 3 originate from the World 2 thought (or cognitive) processes but once formulated linguistically or embodied materially become available for inter-subjective criticism and evaluation. Such World 3 thought contents are different both from World 2 thought processes (involving various kinds of awareness we have of those objective contents) and from World 1 objects (consisting of various written, verbal, or artistic forms of expressions of those objective contents) and thus need to be classified into a separate class of things. What makes any item an inmate of World 3, on Popper's view, is not as much the fact of its being a product of human creation as the fact that it can be grasped, known,

deciphered or criticized inter-subjectively. Characteristically, World 3 objects can be improved by cooperative criticism and criticism can come from people who had nothing to do with the original idea.

The relevance of Popper's pluralistic thesis lies not only in his emphasis on the ontologically distinct character of these World 3 products but in his firm conviction that the question of the reality of these human creations can be addressed regardless of their psychological origin or mind-dependency. This key Popperian insight exposes at once the insignificance of the mind-independence/mind-dependence question for the ontological status of any object. What seems really at stake here is a problem that is of wider significance than the mind-(in)dependency issue, namely, the issue about the chief criterion for *real* existence? This leads us straight into the other important point made by Popper.

Something exists or is real for Popper if and only if, it can interact with members of World 1, that is, with hard physical bodies. Taking his cue from the physicalist's idea of reality, Popper argued that whatever may directly or indirectly have a causal effect upon physical bodies is real [Popper 1979]. That World 3 objects can affect our brains belonging to World 1 and other physical bodies is undeniable. In addition, the World 3 products can causally influence our World 2 experiences as well. Hence the reality of the products of World 3 is evident from the impact they make upon World 1, from their feedback effect upon us by influencing our World 2 thought processes decisively and also from the impact any of us can make upon them.

Another crucial point made by Popper regarding the contents of World 3 concerns their (partial) autonomous character. The notion of autonomy seems to be a problematic one and philosophers concerned with technology are arguing over this concept for quite some time. For instance, drawing on the old Greek idea that artificiality implies controllability, Pitt reasons that for technology to be autonomous, it must be uncontrollable [Pitt 2011]. As we do control, challenge, change, and even reject technology including the large-scale ones (though not all of it, not all the time) the very question of technology being autonomous, argues Pitt, cannot be entertained [Pitt 2011].

Popper's idea of autonomy, however, appears very different from what is usually understood by this term. He drew our attention to how artifacts (and all other World 3 contents) despite being products of the workings of innumerable minds do have a life independent of human intention and endeavor, how they cause their own problems and bring forth unforeseen consequences. It is in this sense, according to Popper, that World 3 objects are (to a considerable extent) autonomous. The examples discussed by Popper are taken mostly from mathematics and except for a few comments on the impact of nuclear reactors or atom bombs on humanity he did not ponder much on the autonomous aspect of artifacts. Nevertheless, the real significance of his argument in defense of the (partial) autonomy of World 3 products comes to light if we care to examine the nature of our dynamic relationships with artifacts. A

closer look into Ihde's phenomenological analysis of how material artifacts *mediate* human-world relations seems most suitable for understanding Popper's notion of autonomy [Ihde 1979].

Let us take the example given by Ihde of a dentist using her probe to gather information about our teeth [Ihde 1979]. The finely tipped probe exists *between* the dentist and what is experienced and in this sense is the *means* of her experience of the texture, hardness, softness, or holes of our tooth. The dentist feels the hardness or softness at the end of the probe and as she experiences the tooth through the probe, the probe is being taken into her self-experiencing. This has an interesting implication, namely, that here touch is *at a distance*, and touch at a distance calls for some material embodiment. However, one also needs to note that simultaneous to the awareness of the tooth as the focal object of her experience, there is the *relative disappearance* of the probe as such.

This disappearance or withdrawal is the way the instrument becomes the *means* by which "I" can be extended beyond my bodily limit. Thus it may be spoken of as a withdrawal into my now extended self-experience. The probe genuinely extends the dentist's awareness of the world, it allows her to be embodied at a distance, and it gives her a finer discrimination related to the micro-features of the tooth's surface. But at the same time that the probe extends and amplifies, it reduces the full range of other features sensed in her finger's touch such as the warmth or wetness of the tooth. This is how a simple stainless steel probe transforms direct perceptual experience.

Artifacts as illustrated by Ihde, therefore, are not neutral intermediaries between humans and the world, but non-neutral mediators [Ihde 1979].⁶ It is this *non-neutrality* of artifacts that constitutes the Popperian notion of (partial) autonomy of World 3 products including artifacts. Artifacts being contents of World 3 are to a large extent autonomous in this particular sense that they have the potential to transform our experience, to affect our actions, and our everyday dealings with the world, in unanticipated ways.

3 Popper on the ontological status of artifacts

A large number of World 3 objects like books or computers or works of art are, according to Popper [Popper & Eccles 1977], *embodied* in World 1 objects and belong to both World 1 and World 3. To take an example, a book belongs to World 3 because of its objective content that remains invariant through various editions and that can be examined inter-subjectively for matters like logical consistency, etc.; but in so far as it is a tangible physical entity it

6. Not all experiences with artifacts, however, are of this type. For a detailed view see [Ihde 1979].

belongs to World 1 as well. Similarly, sculptures, paintings, etc., being tangible receptacles of objective content are inmates both of World 1 and World 3. In contrast, products of human creation that are not yet formulated linguistically or embodied materially are described by Popper as “unembodied” World 3 objects, which do not have this dual ontological status [Popper & Eccles 1977].⁷ In what follows, two arguments are offered with the aim of questioning the dual ontological status of material artifacts as embodied World 3 objects. While the first argument examines the composition and characteristics of such artifacts, the second one focuses on their epistemic and creative aspects.

To begin with, material artifacts despite their physical-chemical make-up cannot, strictly speaking, be inhabitants of World 1 because the internal substance and organization of any such artifact in contrast to a natural object (in the sense explained in footnote 4) is an *engineered* or *designed* structure that bears clear traits of human involvement⁸ and not simply a given assemblage of raw materials. The components of any material artifact, say a pencil, are not raw in the sense that naturally occurring materials like clay or wood are raw, rather they are skillfully and carefully selected, organized, modified, processed or in part refurbished, demonstrating signs of human interference all over. To cite another example, though a rubber ball is immediately made of rubber, it is not to be identified with the part of rubber of which it is composed. That part of rubber may have been synthesized before being formed into a spherical shape to create the ball, and certainly the part of rubber could continue to exist (in some sense) even if the ball were to be destroyed.⁹ According to Popper, though material artifacts are products of World 3 they belong simultaneously to World 1 primarily because of their tangible physical structure [Popper & Eccles 1977]. Upon careful investigation this physical-chemical composition because of which a material artifact allegedly belongs to World 1 emerges clearly as a purposefully designed structure and not as a mere heap of naturally occurring materials. Hence it does not seem reasonable to hold that artifacts existing in tangible forms ought to belong to World 1 as well.

7. An example of unembodied World 3 products could be any hitherto unexplored logical problem situation or hitherto undiscovered logical relations between existing theories.

8. Even the pre-historic stone tools (axes, hammers, etc.) were made by chipping and flaking techniques that required skilled human labor.

9. The problem of coinciding objects is not being raised here for the following reason. The most popular view often referred to as the “standard account” [Lowe 1995] embraces the conclusion that numerically distinct objects, (for instance, a certain wooden table and the lump of wood which composes it) can exist in the same place at the same time. The underlying assumption is: all that needs to be done to a lump of wood in order to make it into a table is to merely change its shape in an appropriate way. Considering contemporary philosophical and engineering research on the design and manufacture of artifacts (e.g., [Bucciarelli 1994], [Kroes & Vermaas 2008]) this view seems too simple to go entirely unchallenged.

What is more, artifacts are generally characterized by a certain *for-ness*, in other words, by a functional or purposeful aspect. Their purposeful or functional nature, however, is neither wholly determined by the physical properties of the constituents nor by external physical factors (such as physical laws or forces) and also cannot be explained in complete isolation from the socio-cultural context of their use.¹⁰ The main reason being, artifact functions are, as Preston explains, *multiply realizable*, that is, they are realizable in a variety of materials and/or forms, provided some general constraints are satisfied [Preston 2009]. Since a given artifact function is realizable in a range of forms and materials, it is no wonder that it can also be performed by other artifacts originally designed to fulfill different functions. Therefore artifacts are *multiply utilizable* [Preston 2009]; typically they serve several functions, often simultaneously. To take Preston's example, an umbrella designed specifically to ward off rain or to be used as a sunshade [Preston 2009], can also be used as a weapon, as a lampshade, as a handy extension of the arm for reaching and retrieving things.¹¹ Hence the mere possession of a tangible structure or certain physical-chemical-geometrical properties cannot be a sufficient ground for including artifacts in World 1. Compositionally and characteristically they differ from World 1 natural objects (in the sense explained in footnote 4).

Before presenting the second argument it is important to note the ontological division Popper made between the *material structure* of an artifact and the *objective content* that this structure is a carrier of. To illustrate, the material structure of a book made out of paper, glue, thread, etc., is ontologically distinct from its objective content possessing certain semantic and syntactic properties. This Popperian division clearly rests on the assumption that the three-dimensional material structure is simply a *carrier* or *receptacle* of the objective content. Two reasons can be offered to contest this underlying assumption.

First of all, Popper seems to overlook the fact that the material structure is as much a product of creative imagination, rational thinking and inter-subjective criticism as the content it embodies. The act of conceptualizing and manufacturing material artifacts intended to meet given human requirements is technically known as design. Design is typically conceived of as a purposeful, goal-directed activity. Such a task-specific process would only be initiated if there is no material artifact that perfectly fulfills the given requirements. In other words, novelty or originality, even in the most modest sense, is a condition needed for the process of design to begin. The design-process is thus widely viewed as a creative process.¹²

10. See, for instance, [Basalla 1988], [Priemus & Kroes 2008].

11. No doubt artifacts have standardized forms and uses that are (relatively) stable for years or even generations. However, what needs to be noted is that they are only *relatively* stable.

12. This, however, is not to suggest that every act of design counts as a creative act in the most elevated sense of the term. A closer look into Dasgupta's analysis

This paper does not intend to endorse the traditional *hylomorphic* model of creation which entails the idea of form (*morphe*) to be imposed by an agent with a specific goal in mind on passive and inert matter (*hyle*). In contemporary discussions relating to engineering design [Franssen 2008], [Ihde 2008] a tendency to counteract this widespread view is already visible. Designers are no longer seen as having a great deal of control over the design-process and the roles played by historical choices, cultural assumptions and social contingencies in the creative process of artifact-design are being seriously considered. Moreover, it is presently argued [Ingold 2007] that the material world is not passively subservient to human designs. In the generation of things the materials with various and variable properties enlivened by the forces of the cosmos actually meld with one another. Hence the processes of genesis and growth that bring about forms in the world are viewed as more important than the finished forms themselves. Now whether one should assign primacy to processes of formation as against their final-products is too big a question to be discussed at this point. Irrespective of the view one chooses to hold, the fact remains that material forms of artifacts brought forth by the processes of design are not elements of the *given* physical World 1.

The second reason concerns the epistemological aspect of material artifacts. Decades ago Ferguson pointed out how in ancient times a vast body of knowledge was conveyed by the pictures and drawings of material artifacts and by the artifacts themselves [Ferguson 1977]. In sharp contrast to verbal or propositional knowledge, this visual or non-verbal knowledge contained and conveyed by the pictures, drawings, or diagrams of these artifacts is characteristically tacit and hard to describe. This kind of knowledge, often referred to as “operational principles” [Polanyi 1962, 176], basically consists of how certain kinds of structural forms and structural materials function, behave, perform, and appear under certain conditions. This very idea of knowledge borne by things (such as scientific instruments) has been made popular by Baird lately [Baird 2004]. Criticising our traditional attitude of thinking about knowledge solely in propositional terms, and of considering theories as the only means for expressing knowledge, Baird introduces a *materialist epistemology* or *instrument epistemology* that accounts for the non-linguistic knowledge embedded in things, specifically scientific instruments, which is typically different from knowledge that our theories bear, and cannot obviously be described as justified true belief [Baird 2004].¹³ He offers numerous intriguing historical cases to argue for the myriad ways in which scientific models and other devices en-

of different levels of creativity would be very helpful at this point [Dasgupta 1996, 53–65].

13. The term “knowledge” is used here in the objective sense as discussed by Popper [Popper 1972]. In the objective sense knowledge can be understood as an evolutionary product of human (intellectual and physical) activities that can be detached from its psychological origin, can be criticized and modified inter-subjectively, and can improve our active adaptation to the world.

capsulate knowledge and urges philosophers to consider scientific instruments as products that do contain and convey knowledge (though in a manner different from theory) and not merely as aids in the generation and articulation of knowledge.

However, Baird's analysis remains restricted to the kinds of knowledge¹⁴ borne by high-profile scientific instruments like direct reading spectrometers or Faraday's first electric motor. The principal motivation to extend Baird's theory to include everyday artifacts like pencils, books, forks or paper clips as constituting knowledge in a non-linguistic way comes from Henry Petroski's [Petroski 1992] meticulous research on the nature of technological invention, on the history of design and engineering and most importantly from his masterly explanations of the evolution of what he calls *useful things*. Drawing on Petroski's painstaking research this section concludes with a sketch of how a paper clip constitutes knowledge in a non-verbal way [Petroski 1992]. The aim is to argue that even as simple and mundane an artifact as a paper clip has an epistemic content which cannot be ignored.

A paper clip (successfully working) is usually made with a steel wire that wants to spring back to its original shape after being bent, but only up to a point, for otherwise the paper clip could not be formed into the object it is. The paper clip works because its loops can be spread apart just enough to clutch some papers and, when released, can spring back to hold the papers. This springing action, more than its shape *per se*, is what makes the paper clip work.¹⁵ Robert Hooke discovered the nature of this spring force in 1660 and published his observation about the elasticity or springiness of materials in 1668. There must be the *right spring* to the paper clip wire, that means, if one were to use wire too hard to bend, then the loop could not be formed; on the other hand, if one were to try to make a paper clip out of wire that could be bent too easily, it would have little spring and not hold papers very tightly. A paper clip then encapsulates in its material form the knowledge of the characteristic springiness of materials and the knowledge of how to apply the *right spring* to the paper clip wire, which may be described as an operational principle. As a non-linguistic expression of heterogeneous knowledge, the paper clip should reasonably belong to World 3. Upon careful scrutiny other material artifacts might also appear as unique manifestations of human imagination, workmanship and of quite a rich combination of knowledge. If we consider this epistemic aspect of material artifacts then the ontological difference assumed by Popper between their tangible structure and the abstract objective content borne by the structure gets blurred. Consequently, his argument proposing the dual ontological status of embodied World 3 products, to be precise, material artifacts seems to lose its strength.

14. Baird speaks of three different kinds of knowledge, namely, model knowledge, working knowledge, and encapsulated knowledge, usually borne by scientific instruments [Baird 2004].

15. Every material that engineers work with, whether it is timber, iron, or steel wire has a characteristic springiness to it.

If artifacts too like ideas and theories can be construed as (non-verbal) expressions of knowledge, traditional philosophical problems relating to the character and growth of knowledge need to be reconfigured in the light of new questions concerning the things we make. For instance, to construe material artifacts as instances of knowledge amounts to questioning the basic postulation of the traditional philosophical theory (of knowledge), namely, that knowledge consists of those true beliefs which can be justified. In addition this involves a rethinking of the notions of truth and justification which are tied to the concept of knowledge but seem hard to fit around artifacts. It is high time philosophers particularly those engaged in the study of artifacts or those interested in epistemological issues should be concerned with the ways human knowledge is encapsulated in a wide variety of material artifacts.

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